QUALITY CONTROL

in the

HONG KONG ELECTRONICS INDUSTRY

W. K. CHIU

Centre of Asian Studies
UNIVERSITY OF HONG KONG
1973

SELECTED SEMINAR PAPERS ON CONTEMPORARY CHINA I

edited by Steve S. K. Chin and Frank H. H. King

This collection of essays is based on a seminar in the Centre of Asian Studies organized by Jack Gray and entitled 'From Thought to Policy: the Practical Consequences of Mao Tse-tung'.

Of this collection the *Journal of Asian Studies* has written (Vol. XXXI, November 1971):

The opening essay by Jack Gray is an especially imaginative attempt to explain policy changes in the 1960's, particularly that of the "Cultural Revolution," in terms of the ideology and policy guidelines fashioned by Mao during the guerrilla period of the twenties and the thirties. This is followed by essays touching upon the importance of Mao's efforts to translate ideology into practice, economic organization within collective farms, social change in the sphere of educational work, changes in marriage and family institutions, religion in China today, Lin Piao's Military Tactics, 1937–1945, and the character of the Ninth Central Party Committee.

The quality of these contributions is rather uneven, but generally speaking, quite high: see in particular, the essay dealing with Lin Piao's military tactics by Lee Ngok which is based upon substantive research, replete with military sketch maps, and offering new insights into Chinese guerrilla military campaigns and strategies. This collection of essays should definitely be purchased by libraries specializing in contemporary Chinese studies.

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QUALITY CONTROL IN THE ELECTRONICS INDUSTRY IN HONG KONG

THE TERM quality control (Q.C.) in its broad sense refers to the total activities of the staff of a company in carrying out its quality objectives. It has become an essential part of the management of modern mass production. An efficient quality control and assurance programme has the effect of improving quality and reliability at reduced costs. The more expensive products demand higher and more consistent quality and hence require more attention to the control of quality.

In the past twenty years Hong Kong has converted itself from a place for entrepot trade into an industrial city, with its abundant labour supply, its special political and geographical situation, and its enthusiastic industrialists. The sixties were especially characterised by the fantastic rate of economic growth, largely due to the success of a number of exports-oriented light industries. However today Hong Kong is faced with several serious problems, such as rapid increase in wages and rents, extreme shortage of industrial sites, high turn-over rate of workers, economic pressure from the customers' countries, insufficient provision of basic and advanced technical education, and strong competition from neighbouring developing countries. These problems will become more acute in the near future. It is predictable that Hong Kong will soon lose its leading position in the supply of inexpensive goods and will have to develop more products of higher quality and price to meet this challenge. Along with the other advanced production and management technological knowhow required for this purpose, quality control is seen to play a very important role in the future of Hong Kong's industry.

The purpose of the present study is to provide some statistical information on the current state of quality control in the electronics industry and to promote general interest in the problem of quality control.

The electronics industry is one of the young and booming industries in Hong Kong. It has made big strides since 1965 when there were only 29 electronics factories. In March, 1970, the industry had 142 undertakings (see [2]) employing 33,000 workers or 6.9% of the Hong Kong labour force. Transitor radios, T.V. sets and parts, semiconductors, diodes, integrated circuits, and even computers are produced. Owing to the delicate nature of the products, the industry needs comparatively advanced technological knowhow and good control over the quality. In the Second Electronics Manpower Survey [2] it was reported that Q.C. technicians and operators form the third biggest group of workers in that industry. Despite the fact that serious Q.C. ideas have not yet drawn the general attention of the industrial sector in Hong Kong, quality control is commonly enforced in the electronics industry. It is for this reason the electronics industry was selected for the present study.

1. Method of Study

Scope. Considering that the number of undertakings in the industry is relatively small and that a factory of too small a size cannot have significant Q.C., we decided to include in the study all electronics factories with at least ten employees. This is in similar practice as [10]. The names and addresses of the firms were supplied by the Labour Department [8].

Pilot Study and the Questionnaire Design. The present research is the first Q.C. survey ever conducted in Hong Kong. A pilot study thus was thought essential to the final design of the questionnaire. A preliminary questionnaire was drafted and personally was taken to ten factories for comments and advice from their Q.C. managers. Generous co-operation and numerous valuable opinions were received.

The final form of the questionnaire (see Appendix) was prepared in December, 1970, and was printed in English and Chinese. It consisted of 40 questions, grouped into five sections: I. General (five questions), II. Organisation of Quality Control (eight questions), III. Quality Control at Various Stages of Production (sixteen questions), IV. Statistical Methods used in Quality Control (two questions), and V. Miscellaneous (nine questions).

Procedure of the Survey. Of the 142 electronics factories, eight employed less than ten persons and were excluded from the study. Questionnaires were sent to the remaining 134 factory managers, who were requested to appoint a suitable person to return the answers. The covering letter guaranteed strict confidence in the handling of the data, with assurance that information would be published only in the form of statistical summaries without identification of individual firms. A telephone explanation service was operated to answer any queries about the questions. Owing to the length of the questionnaire, the response rate was, as expected, not very high at the first stage (January, 1971). In February and March the Research Assistant of the project was asked (a) to send reminders, with follow-up telephone calls, and (b) to visit all those factories whose Q.C. managers indicated a preference for a personal interview before completing the questionnaire. Each returned questionnaire was checked and edited. Ambiguous answers were clarified by telephone.

Difficulties Encountered. A number of factories refused to participate apparently because some of the questions[1] were regarded to involve 'business secrets'. Some factory managers were not interested in the study because they were 'too busy'. In some other factories, usually of smaller size, it was

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[1] Questions concerning a company's financial state, administration system or production conditions such as questions 3, 5, 7-10, 13, 15-19, 27, 28, 32, 33 and 36 of the Appendix are liable to be regarded to involve the company's business secrets. Such business attitudes are often held with regard to an academic survey without a legal backup.

difficult to identify a suitable person to provide an answer. Despite these problems the perseverance of the follow-up work resulted in a reasonably high response rate. (Section 2 refers.) Another difficulty was the Q.C. terminology used by different factories. For example, some factories have a Q.C. department, some have a Q.A. (quality assurance) department, and some have both. To overcome this type of difficulty, terminologies with the broadest possible meaning were used. In the case of the example quoted, the term 'Q.C./Q.A. department', instead of 'Q C. department', was used in the questionnaire. Finally, this type of Q.C. survey is complex and technical and, at the time of the survey, was new to the Hong Kong manufacturing industry. Extensive follow-up work was undertaken to overcome this final difficulty.

2. The Response Rate

AT THE end of the survey it was found that, of the 134 factories investigated, eight had closed down and nine were branch factories whose answers were included in those of their head offices. This survey, therefore, covered 117 electronics undertakings. The factories were classified into small (10 - 99 employees), medium (100 - 199 employees) and large (200 employees or over), in accordance with the criteria of the Labour Department. The response rate is shown in Table 1.

Table 1

Response Rate

Factory size	No. surveyed	No. responded	Response rate
Large	37	30	81.1%
Medium	26	17	65.4%
Small	54	27	50.0%
TOTAL	*117*	*74*	*63.2%*

It is seen that the large enterprises responded more actively (81.1%) than the small and medium undertakings. In fact, all the eleven largest factories with more than 1000 employees participated in the study. The overall response rate(63.2%) is a high figure, compared with those Q.C. surveys conducted in Japan in 1969 (30.1%) [10], and in Taiwan in 1970 (31.5%) [9].

The total number of employees in the industry in March, 1971, was estimated to be approximately 38,400 based on [2] and [8]. The 74 factories which replied included about 32,400 employees or approximately 84.4% of the working population of the industry.

It thus can be stated that the results of this study are reasonably representative of the current state of quality control in the electronics industry in Hong Kong.

3. Some Fundamental Concepts

IT WILL be useful to sketch some of the fundamental ideas of quality control before discussing the results of the present survey. For a more

detailed exposition of the subject the reader may wish to refer to Feigenbaum [3] and Juran [6].

The practice and theory of quality control has evolved in five stages — the operator quality control, the foreman quality control, the inspection quality control, the statistical quality control (S.Q.C.), and the total quality control (T.Q.C.). Important academic research and rapid practical advancements have been made in the last two stages. Statistical method was introduced to the manufacturing industry in the early 1930's, and its applications were accelerated by the Second World War which marked the beginning of high speed mass production. Statistical method offers a scientific means to inspect a small portion of the articles produced and, therefore, allows the manufacturer to be more effective in decision making and forecasting. The two common tools, control charts and acceptance sampling plans[2], have helped manufacturers to reduce substantially production costs and to stablize product

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[2] A control chart is used mainly to help in tracing and eliminating the appearance of an unusual cause of quality variation. Quality characteristics, such as the mean resistance or the proportion of defective items, are calculated from samples taken hourly or daily from the production line and recorded chronologically on a chart, called the 'control chart' on which are drawn suitable 'control limits', determined by certain statistical method. When the curve wanders within the limits and behaves reasonably well, the production is said to be 'in control'. Otherwise it is said to be 'out of control'. In the latter case, an investigation of the process for any special cause of quality variation is required in order to prevent future possible deterioration in quality.

An acceptance sampling plan is operated to assess the quality of a batch produced or received. Batches of product, usually of large sizes, are submitted for inspection. In the simplest (and the most important) scheme, called the 'single sampling for attributes', a sample of n items is required to be taken from each batch, and the number of defectives counted. If the number of defectives observed is not more than c, called the 'acceptance number', the batch is accepted. Otherwise it is rejected. Accepted batches may be consumed or further processed, and rejected batches may be scrapped or reworked. Various criteria have been developed for the design of acceptance sampling plans.

quality. However, in this 'statistical' stage, quality control remained the concern of only a small part of the company's staff. The improvement of quality (a change of product design or an effort to meet the special demand of a particular market) and the reduction in costs on a larger scale were hard to achieve because of lack of satisfactory coordination between the Q.C. and other departments. Beginning in the late fifties, quality control was gradually recognized as a management problem which, to be effective, had to integrate the efforts of general management, personnel administration, accounting, production engineering, statistical method, and the like. From this point of view, quality control is 'everybody's business', with each person looking after a certain part of the overall programme. This is the stage of 'total quality control' which has brought about fruitful results in some practical situations and still is being seriously developed.

The jobs of a T.Q.C. programme may be classified under four headings new design control, incoming material control, production process control, and special process studies. In practice, all functional components of the company are responsible for one or more areas of these jobs. A centre component has to be set up for coordinating these jobs. This centre component is usually identified as the 'quality control department' or the 'quality assurance department'. The Q.C. manager has the managerial and functional responsibilities for quality control engineering, quality information equipment engineering, and process control engineering which includes inspection and testing. On the top management level, the managing director or, in some factories, the quality committee which is formed by the relevant heads of departments or engineers, will decide upon important quality policies (usually recommended by the Q.C. department) and see that jobs are properly assigned with minimum personal friction. Down to the primary producers level, morale and quality consciousness are maintained and stimulated by training courses, posters, competitions, and the like. The supervisors and operatives are sometimes encouraged to set up quality control study groups (or, quality control circles, as the Japanese call

them) or to participate in a zero-defects programme[3]. It thus is seen that an ideal T.Q.C. scheme aims at making every member of the company conscious of the quality and the costs of the product.

In practice, however, few factories can accomplish a complete T.Q.C. management. In Hong Kong most electronics undertakings of medium size or larger are practising quality control programmes which are mid-way between simple inspection and T.Q.C. They have a Q.C. or a Q.A. department which performs a limited number of work elements. This department often expands in one form or another to increase its responsibility. In general the Q.C. component is primarily concerned with the inspection job and the application of some standard statistical techniques and is partially responsible for other quality control activities.

4. Sampling Method as a Means of Quality Control

ACCEPTANCE SAMPLING is recognized as an important statistical means of quality control in the incoming material stage, the manufacturing stage, and the final monitoring stage. To present a typical picture of how the sampling method is practised, the following passage of Chiu and Wetherill [1] is quoted, with minor modifications.

> The electronics industry is one of the many successful and fast developing industries in Hong Kong. The general situation is the following. Chief Products manufactured are transistors, transistor radios, portable T.V. sets and parts, diodes, integrated circuits, and small computers, the first two groups being the majority. The large factories usually have one or two fixed customers in the United States. The customers normally accept goods in accordance with the

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[3] Zero-defects (ZD) is a new quality concept that stresses prevention, rather than detection, of defects. A ZD programme works on three key objectives: (a) to motivate every employee to do his job, whatever it may be, and do it right the first time, (b) to instill in every individual a pride of performance and craft, and (c) to stimulate each person to strive to prevent errors before they occur.

MIL-STD-105D[4] scheme. Transportation is difficult and so rejected batches are not returned to Hong Kong but sorted, scrapped, or repaired by the customer, costs being charged to the manufacturer. Due to the delicate nature of the products, quality control is commonly enforced in this industry and the methods are largely influenced by the American system. The AQL (see footnote 4 below) for outgoing product inspection is usually set tighter than the vendee's requirement, to avoid too much after delivery sorting and repair costs. The following are two typical examples of the quality control practices:

Semi-conductors A large factory manufactures semi-conductors, ranging from simple transistors to integrated circuits. At an important intermediate stage, items are 100% inspected on one or several critical factors that frequently cause quality variation, by the production staff. As manual skill is important in the production, it is not uncommon that certain particular mistakes in operations appear. This is usually discovered and corrected fairly quickly by the 100% inspection procedure. Semi-finished items are accumulated at the end of the line to await a sampling inspection performed by the Q.A. staff who visits the line a few times per shift. The Q.A. inspector takes a random sample of **n** (usually, n = 100 or 200) from the work completed. If not more than c (usually, c = 0, 1, or 2) defectives are found, the production is undisturbed and the product is passed to the next stage. Otherwise the line is held up and the operatives are asked to screen and rework the items produced since last inspection. The Q.A. inspectors look after several lines on the same floor. The sample size and the acceptance number are determined to meet some specific AQL, using MIL-STD-105D and on the ground of administration convenience. Screening and re-work is an unpleasant job and is usually unnecessary. If this is called for, the foreman can normally quickly identify the fault causing the defect and eliminate it from the future production.

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[4] The Military Standard 105D (abbreviated MIL-STD-105D) is an official document of sampling procedures and tables for inspection by attributes, approved by the Department of Defence, U.S.A. It is primarily intended for use by the Departments of the Army, the Navy, and the Air Force and the Defence Supply Agency. It has achieved a considerable popularity in the industry in many countries. The acceptance sampling plans are indexed by acceptable quality levels (AQL). The AQL is defined as the maximum percent defective, or the maximum number of defects per hundred units, that, for purposes of sampling inspection, can be considered satisfactory as a process average.

There is a final sampling inspection and a reliability test on the finished product. The former uses the MIL-STD-105D criterion with an AQL tighter than that required by the customer. Internal failure percentage is recorded daily.

Transistor Radios Transistor radios are assembled in another factory. At the end of each assembly line there sits a Q.C. girl (of the production department) in a small cubicle, insulated from the surrounding noises. Her job is (i) to tune and regulate the knobs, (ii) to diagnose any faulty parts. This is done on 100% examination basis, and any defective articles found are passed to a girl of the line specially doing the repair job. Effective articles are passed on for covering, decorating, and packing.

Finished radios are batched and cannot be released until they have passed a sampling inspection by the Q.A. department. A small sample is taken from each batch and each radio is carefully examined on its appearance, mechanical performances, and electrical performances. Defects are classified into four classes and demerit values are assigned, as follows: class A — very serious defect, causing an operating failure which cannot be corrected in the field, e.g. a broken amplifier, demerit value = 100; class B — serious defect, causing an operating failure that can be corrected rather easily, e.g. loose contact, demerit value = 50; class C — moderately serious defect, causing trouble of a nature less serious than an operating failure, e.g. dirty contact and finish conspicuously scratched, demerit value = 10; class D — not serious (incidental) defect, e.g. a mark on the cover that can be rubbed away, demerit value = 1. Defects are of undenumerable natures and the classification is not made solely on the basis of departure from specification but also of the cost of repair. Experience is an important factor of correct classification. The total demerits divided by the sample size is a criterion for acceptance or rejection of the batch. This criterion is determined with special reference to the customer's requirement.

Another transistor radio set factory rates the finished product by AQL's for the critical, major A, major B, and minor defects found in the sample.

On the whole, it is seen that (i) a large amount of effort and costs has been devoted to the prevention and internal failure sectors of the quality control exercise because of the relatively low labour wages, and high transportation expenses, and (ii) sampling plans are determined subjectively and passively to meet the customer's need. However, Hong Kong industries are today facing three growing difficulties: shortage of labour supply, rapid rise in wages, and strong competition from neighbouring countries. A policy based on a clever balance between the defective rate in the out-going product and the quality control costs could effectively improve the company's competitive power.

5. Situation of Quality Control Enforcement

WE NOW may look at the statistical summaries of the present survey and study their implications.

In this section we shall study the situation of Q.C. enforcement in the electronics industry in terms of the evolution of the Q.C. departments and the adoption of modern management systems. It is to be noted here that the term 'Q.C. department' is used to include also 'quality assurance department', 'quality assurance and reliability department', or 'quality control section', which may be used in some factories.

Table 2 shows the time of establishment of the Q.C. department relative to the time of establishment of the factory. We see, in the first instance, that 64 out of 74 factories (86.5%) are enforcing Q.C. in the sense that they have a Q.C. department. Only 10 (13.5%) are not enforcing Q.C.; nine of these are small factories and the tenth one is medium in size.

Table 2

Time of Establishment of the Q.C. Department*

	Same time	Later	Not yet established	TOTAL
(A) By factory size				
Small	14	4	9	27
Medium	12	4	1	17
Large	26	4	0	30
TOTAL	52	12	10	74
(B) By chief customer				
Local customer	14	6	9	29
Foreign customer	35	6	0	41
Unknown	3	0	1	4
TOTAL	52	12	10	74
(C) By factory owner				
Local owner	25	6	10	41
U.S. owner	21	5	0	26
Other owners	4	1	0	5
Unknown	2	0	0	2
TOTAL	52	12	10	74

*Relative to the time of establishment of the factory

Of the 64 enterprises enforcing Q.C., a very large number, 52, established the Q.C. department at the beginning of the business; 12 established the Q.C. department at a later stage of the development of the factory. Table 2 also classifies the time of introducing Q.C. by chief customers and by factory owners. It can be seen that all the ten factories without a Q.C. department are locally owned and nine of them are selling their products to local customers. It can be concluded that factories having a foreign customer or a foreign owner are more serious about quality standard.

It is interesting to note further that 87.5% of the 64 Q.C. departments are administratively independent of other departments and are directly under the plant manager; the other 12.5% are not independent but belong to some other departments.

Table 3 analyses the state and ways of expansion of the Q.C. departments since their establishment. We can see that 46 have undergone expansion in one way or another; most of them belong to medium and large factories. On the other hand, of the 18 unexpanded Q.C. departments, 13 belong to small factories.

Part (B) of Table 3 describes the chief ways of expansion of the 46 expanded Q.C. departments. Large factories have more variety in this respect.

Table 3

Expansion of the Q.C. Department since Establishment

	Size of factory			TOTAL
	Small	Medium	Large	
(A) State of expansion				
Expanded	5	13	28	46
Not expanded	13	3	2	18
Not applicable	9	1	0	10
TOTAL	27	17	30	74
(B) Chief method of expansion				
More staff or better knowhow	4	4	9	17
Enlarged inspection area	1	3	3	7
Became an independent department	0	1	0	1
Setting up q. engineering section	0	0	1	1
Introducing life & reliability tests	0	1	3	4
Overseas expert joining the department	0	0	1	1
Introducing T.Q.C.	0	0	2	2
No information supplied	0	4	9	13
TOTAL	5	13	28	46

Another angle of looking at the state of Q.C. enforcement is to see to what extent modern ideas have been adopted. Table 4 gives some brief information on this subject. One can conclude from these figures that Hong Kong is not quite up-to-date in organizing Q.C. activities.

Table 4

Adoption of Modern Q.C. Systems

System	Number of practising factories
Quality committee	12
Quality control circle	5
Zero defects programme	1
Total quality control	2

6. Staff and Education for Quality Control

THE SECOND Electronics Manpower Survey [2] reported that in March 1970 the total number of workers (including those of the technician level) in the industry was 32,597 and the number of Q.C. technicians and operators was 2,383. This means that 7.3% of the labour force of the industry were directly performing quality control jobs. Alternately, one has the following Q.C. staff ratio:

No. of Q.C. workers : No. of other workers = 1 : 12.7

In the same survey, 289 Q.C. vacancies were reported. Therefore, of the 2,672 Q.C. posts available, 10.8% were vacant.

The present survey investigates not only the staff situation but also the training of the Q.C. workers and senior members. The results are tabulated below.

Table 5

Q.C. Staff and Training

	Managers and engineers		Technicians and supervisors		Operators and inspectors		TOTAL	
(A) Posts								
No. employed	143	90.5%	308	81.9%	1708	90.2%	*2159*	*88.9%*
Vacancies	15	9.5%	68	18.1%	186	9.8%	*269*	*11.1%*
TOTAL	*158*	*100.0%*	*376*	*100.0%*	*1894*	*100.0%*	2428	100.0%
(B) Training								
No. joined internal training classes	11	18.6%	97	79.5%	477	95.6%	*585*	*86.0%*
No. joined external training classes	39	66.1%	25	20.5%	22	4.4%	*86*	*12.6%*
No. joined training courses abroad	9	15.3%	0	0.0%	0	0.0%	*9*	*1.3%*
TOTAL	*59*	*100.0%*	*122*	*100.0%*	*499*	*100.0%*	680	99.9%

In part (A) of the table, we can see that the number of posts available for Q.C. workers (technicians and operators levels) in the 74 participating factories is 2270 and of these 11.2% are vacant. This figure is only slightly higher than the corresponding figure, 10.8%, mentioned above. This close agreement of the two percentages may be seen as another indication of the representativeness of the present survey.

The percentages of vacancies at the three levels — managers and engineers, technicians and supervisors, and operators and inspectors — are 9.5, 18.1, and 9.8 respectively. It is thus seen that the mid-level Q.C. personnel are in greatest shortage.

The different ways of training Q.C. staff are shown in part (B). A much higher proportion of senior members than of junior members has been trained by external or overseas Q.C. courses. The Q.C. technicians, supervisors, and operators have not had sufficient opportunities to join external classes. In fact in Hong Kong very few Q.C. training courses have been available to the public and, when available, they were often run for Q.C. managers and engineers. As to training conducted within the factory, only 585 persons had an opportunity to join formal classes; the remaining 1479 persons were given two-to-three weeks of on-the-job training.

7. In-coming Material Control

IN-COMING material control is the first (and an important) step in the control of product quality, as poor materials certainly will cause a great deal of trouble later in the manufacturing process. One common, but unsatisfactory, concept of in-coming material control emphasises the inspection and rectification of accepted materials, without paying much attention to the origins of the materials supplied. In fact, the establishment of a good vendor-vendee relationship is of primary importance in the modern idea of total quality control.

The vendor-vendee relationship in the electronics industry is summarized in Table 6. Part (A) informs us that more than one-third of the factories are experiencing frequent delay in the supply of materials. This is quite serious as delay means loss or causes extra load in the production schedule. In part (B) we observe that local and foreign vendors are equally likely to be unpunctual. 'Vendor's poor productivity' appears

Table 6

Vendor-Vendee Relationship

		Number	Per Cent
(A)	Supply of principal materials		
	Satisfactorily punctual	47	63.5
	Frequently delayed	26	35.1
	No answer	1	1.4
	TOTAL	*74*	*100.0*
(B)	Vendor of delayed materials		
	Local	25	33.8
	Foreign	23	31.1
	Local and foreign	4	5.4
	Branch/same factory	7	9.5
	No answer/not applicable	15	20.3
	TOTAL	*74*	*100.0*
(C)	Reasons of delay*		
	Late placement of order	11	
	Difficulty in transportation	15	
	Vendor's poor productivity	27	
	Intentional delay to avoid rejection	7	
	No other competitive vendors	4	
	Other reasons	2	
	No answer	26	
(D)	No. of vendors disqualified by vendee in 1970		
	0	22	29.7
	1 - 3	25	33.8
	Over 3	16	21.6
	No answer	11	14.9
	TOTAL	*74*	*100.0*

* More than one reason may be supplied by a participating factory.

to be a very common reason for delay as is shown in part (C). In the year 1970 at least 41 factories disqualified one or more of their vendors for one reason or another [part (D)]. These facts point to unsatisfactory vendor-vendee relationships.

Q.C. department is, theoretically, an appropriate unit to inspect and accept in-coming materials. Forty-two (56.8%) of the 74 participating factories let their Q.C. department undertake this inspection job. Most of these factories are large and medium in employment size. The next most common unit to undertake acceptance inspection is the production department. There are 18 (24.3%) such departments performing acceptance inspection. Of these 18, 13 are small factories. These figures are found in Table 7.

Table 7

Inspection of In-coming Materials

Department undertaking the inspection	Small factories		Medium factories		Large factories		TOTAL	
Q.C. department	5	18.5%	12	70.6%	25	83.3%	*42*	*56.8%*
Production department	13	48.1%	2	11.8%	3	10.0%	*18*	*24.3%*
Engineering department	2	7.4%	1	5.9%	1	3.3%	*4*	*5.4%*
Store department	4	14.8%	1	5.9%	0	0.0%	*5*	*6.8%*
Other department	0	0.0%	1	5.9%	1	3.3%	*2*	*2.7%*
No inspection	3	11.1%	0	0.0%	0	0.0%	*3*	*4.1%*
TOTAL	*27*	*99.9%*	*17*	*100.1%*	*30*	*99.9%*	74	100.1%

Normally when a factory abandons acceptance inspection it means that the vendor is trustworthy and the quality of the materials supplied is stable. However the three small factories (Table 7) that do not have this inspection steps cannot be taken to be representative of the general truth of this statement,

because they are subcontractors of large factories and have to accept whatever is supplied and produce whatever is required according to instruction. No large or medium factory can afford to run the risk of not having in-coming inspection.

An analysis of the sampling inspection plans used in the in-coming material control stage will be discussed in Section 10 (Table 10).

8. Design of Products

EACH PRODUCT needs a detailed design before it is put into the manufacturing process. The product design includes specifications of the materials needed; the measurement, quality, and reliability of the product; the procedure of manufacturing, and the estimates of cost and profit. The design of a new product involves not only the engineering department, which is equipped with the technological knowledge, but also many other components of the company. For example, (a) the market research department investigates the present and future demands of the local and overseas markets; (b) the complaints and service department provides valuable feedback information on the quality of the product sold; (c) the accounts department helps make a balanced estimate of the cost and profit; (d) the quality control department advises on the agreement between quality specifications and process capabilities and on the manufacturing difficulties encountered in the past or to be faced in the future; (e) the sales representative obtains the order or opens the market.

The situation of these problems in the electronics industry is shown in Table 8. Table 8 has not classified the factories by size because, in the raw data, different sizes have not presented significantly different patterns of distribution.

The majority, 83.8%, of the participating factories design their new products in the engineering department. This is a proper practice. A relatively small proportion, 28.4%, change the quality specifications frequently; a much larger proportion, 63.5%, change them only occasionally. Under the latter circumstances, in which a production process may continue for a long

Table 8

New Design Control

		Number	Per Cent
(A)	Department undertaking new design		
	Engineering department	62	83.8
	Production department	5	6.8
	Other department	3	4.1
	No answer	4	5.4
	TOTAL	*74*	*100.1*
(B)	Change of quality specifications		
	Frequently changed	21	28.4
	Occasionally changed	47	63.5
	Never changed	6	8.1
	TOTAL	*74*	*100.0*
(C)	Reasons for change of specifications*		
	Request by customers	43	
	Market competition	20	
	Suggestion by Q.C. department	19	
	Customers' complaints	6	
	Other reasons	4	
	No answer/not applicable	8	
(D)	Role of Q.C. department in new design		
	Consulted	51	68.9
	Not consulted	15	20.3
	No answer	8	10.8
	TOTAL	*74*	*100.0*
(E)	Feedback of customers' complaints information		
	Practising	49	66.2
	Not practising	21	28.4
	No answer	4	5.4
	TOTAL	*74*	*100.0*
(F)	Estimate of Q.C. cost in total cost		
	5% and below	10	13.5
	6% - 10%	4	5.4
	Over 10%	2	2.7
	No estimate	46	62.2
	No answer	12	16.2
	TOTAL	*74*	*100.0*

* More than one reason may be supplied by a participating factory.

period, statistical methods are most helpful. Forty-three factories change their product specifications upon the requests of their customers. In fact, in Hong Kong most factories 'manufacture to order' and, therefore, design their new products according to the customers' instructions. The next two common reasons for changing the quality specifications are 'market competition' and 'suggestion by Q.C. department'. The Q.C. department is often (68.9% of the time) consulted in the new design. There are 66.2% factories which have a feedback system for customers' complaints information. Thus, on the whole, the design job is satisfactorily done, although very few genuine new products have been invented or initiated in Hong Kong.

9. The Manufacturing Process

IN MASS production a proper control over the production process will be useful in stablizing the quality, thus preventing the occurrence of too many defectives. A constant check thus is necessary on the performance of the process in order to discover existing trouble or problems likely to arise. The traditional practice is to assign the production unit, or more specifically the shop operatives, to perform routine tasks of in-process control, including inspection, recording, and drawing charts. This is because the production workers have close contact with the process and know the manufacturing characteristics best. In the electronics industry, a moderate proportion, 47.3%, of the factories assign this job to the production department (Table 9). An equal proportion, 47.3%, have it done by the Q.C. department. The shop operatives who undertake the in-process control need to acquire adequate Q.C. training.

The Q.C. department should be involved in the final inspection to guarantee the outgoing quality. At this stage some factories perform a full inspection of the lots, some perform a sample inspection, and some perform both. The better organized factories usually invest a considerable sum of money in the equipments for life and reliability tests. They are

rewarded by obtaining more quality information for future improvement. Part (B) of Table 9 informs us that 70.3% (which is quite a satisfactory figure) of the factories let their Q.C. departments do the outgoing product quality inspection.

The statistical techniques for the in-process control and the final auditing inspection plans will be discussed in the next section.

The 'rework rate' in Table 9 is determined by dividing the number of finished items that need repair or rework by the size of the whole lot produced. Generally (87.8% of the time), this rate is small. This implies that the operators are skilful and the in-process control is in general satisfactorily done.

The 'rejection rate' equals the number of items returned by the customer divided by the total number submitted. As the major market of the industry is overseas, particularly the U.S.A., both the customer and the producer generally do not want to have the whole lot returned to Hong Kong even if it cannot pass the acceptance inspection. The normal practice under such circumstances is for the customer to screen the lot and return the defective items or repair them in his own workshop at the expense of the producer. Therefore in general (73.0% of the time) the rejection rate is 5% or below. This is, to some extent, also indicative of the general satisfaction of the customer with the quality.

Despite the fact that 35.1% of the factories suffered frequent delays in the supply of principal materials, (see Section 7), 82.4% could usually complete the production schedule punctually. One can imagine how hard-working and perseverant the executives and workers have been.

The above analysis throws some light on the means by which the industry has achieved success.

Table 9

Process and Finished Product Controls

	Number	Per Cent
(A) In-process control performed by		
Q.C. department	35	47.3
Production department	35	47.3
Engineering department	3	4.1
No answer	1	1.4
TOTAL	*74*	*100.1*
(B) Finished product inspection performed by		
Q.C. department	52	70.3
Production department	9	12.2
Finished product department	6	8.1
Other department	3	4.1
No answer	4	5.4
TOTAL	*74*	*100.1*
(C) Rework rate		
Small	65	87.8
Quite big	7	9.5
No answer	2	2.7
TOTAL	*74*	*100.0*
(D) Rejection rate		
5% and under	54	73.0
Over 5%	11	14.9
No answer	9	12.2
TOTAL	*74*	*100.1*
(E) Punctuality of production schedule		
Usually punctual	61	82.4
Not punctual	11	14.9
No answer	2	2.7
TOTAL	*74*	*100.0*

10. Applications of Statistical Method

THE STATISTICAL method was deliberately omitted from previous discussions of inspections at various stages in order to provide a combined treatment here (Table 10). The 100% inspection is quite commonly applied in the process and final inspections. It is particularly common in large factories (18 out of 30) in the final inspection stage. However it has been established that sampling inspection is generally much more economical than, yet as effective as, 100% inspection. One has the impression that many of these 100% inspections can be replaced by sampling; in fact through the use of recently developed theories, these sampling methods can be designed on the basis of cost minimization.

In the application of sampling inspection, a large number of factories (30-odd) do not use standard sampling tables but instead use their self-designed schemes in the three stages of control. The use of these special sampling inspection methods tends to imply that the risks of wrong decisions may not be accurately determined. It is to be noted that in this group the majority are small and medium factories.

The sampling tables MIL-STD-105D are widely applied in the industry. This is a natural result of the close business relationship between Hong Kong and the United States. Twenty factories use these tables in the in-coming control, nine in the process control, and twenty-two in the final control. The majority of those using standard sampling tables are large factories. The Doge-Romig tables[5] are used only by two small and medium companies.

In connection with the lot quality levels used as a criterion to select the sampling plan, AQL is more common than AOQL and LTPD (see footnote 5 below).

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[5] These tables can be found in the book by Dodge, H.F., and Romig, H.G. (1959): Sampling Inspection Tables — Single and Double Sampling, 2nd ed., New York, John Wiley & Sons Inc. The tables are applicable mainly to the manufacturer inspecting his own product and either accepting on the sampling results or rectifying the batch and then accepting. The plans were indexed by average outgoing quality limits (AOQL) and also by lot tolerance percent defectives (LTPD). The AOQL is defined as the maximum value of the average outgoing percent defective of the product based on the acceptance-rectification sampling inspection practice. The LTPD is defined as some chosen limiting value of percent defective in a lot representing what the consumer regards as unacceptable quality.

Table 10

Inspection Methods

		In-coming			Process			Final		
		Small & medium factories	Large factories	TOTAL	Small & medium factories	Large factories	TOTAL	Small & medium factories	Large factories	TOTAL
100% inspection		10	6	*16*	20	11	*31*	10	13	*28*
Sampling tables	MIL-STD-105D	5	15	*20*	1	8	*9*	6	16	*22*
	Dodge & Romig	2	0	*2*	2	0	*2*	2	0	*2*
	Self-planned	23	10	*33*	22	13	*35*	25	8	*33*
	Others	1	0	*1*	0	0	*0*	0	0	*0*
Quality level	AQL	8	17	*25*	8	12	*20*	10	18	*28*
	AOQL	3	2	*5*	2	1	*3*	5	2	*7*
	LTPD	2	3	*5*	1	2	*3*	2	2	*4*
	Others	0	0	*0*	0	1	*1*	0	1	*1*

Note: There are 44 small and medium factories and 30 large factories in the study

Twenty-odd factories use AQL in the three inspection steps. Again, in this group the majority are large factories. It is interesting to note that in the process control, while only nine factories use MIL-STD-105D, 20 use AQL. It is felt, with partial evidence, that the AQL concept has not been appropriately understood by some sampling plan designers.

In quality control the statistical method is one of the chief techniques in all major jobs. Table 11 summarizes the common statistical methods, other than sampling plans, used by the 74 factories. The simplest method of 'daily record of percent defectives' is most commonly (59 factories) adopted. The next three techniques — cause-effect diagram, demerit rating system, and correlation analysis — are used by 11 factories each. Surprisingly few factories use control charts, whether for attributes or for variables surveillance.

Table 11

Other Statistical Techniques used in Q.C.

Statistical method	Small factories	Medium factories	Large factories	TOTAL
Daily record of percent defectives	17	16	26	*59*
Cause-effect diagram	1	4	6	*11*
Demerit rating system	1	3	7	*11*
Correlation analysis	1	3	7	*11*
Histogram	0	2	6	*8*
Experimental design	0	4	4	*8*
p chart	1	3	4	*8*
$\bar{X}$-R charts	0	0	5	*5*
Pareto diagram	0	1	1	*2*
Others	0	0	2	*3*

The distributions are quite distinct among the different factory sizes. Statistical techniques are less practised among the small factories but have found more applications in the large factories.

It is thus seen that the effects of statistical methods in quality control have not been fully appreciated by a considerable number of factories.

11. Conclusions

THE ELECTRONICS industry is basically an assembly industry. The control of assembly quality falls mainly into two functions — the line function which is responsible for the inspection and test activities and the staff function which is responsible for the planning, monitoring, and prevention activities. The method of tying these two functions into the organisation structure has been developed in two divergent schools of thought. The older school places the line function under production and gives the name 'quality control' or 'quality assurance' to the staff function. The newer school places both line and staff functions under a quality control manager, regarding both as part of 'total quality control'. The argument for this latter form is that final inspection should be paid for only once, not twice as the older school often requires.

From the discussion and analysis of the above sections, one may conclude that, on the whole, the quality control situation in the electronics industry has been satisfactory, following the older school of thought of organization. However, if one bears in mind the sort of industrial difficulties mentioned in the Introduction and that modern T.Q.C. method is more effective and economical in producing sound and reliable goods, one can see that there is still plenty of room for improvement. The following points indicate the directions where improvement is desirable.

Better Organisation of the Q.C. System. At present the Q.C. departments in most electronics factories are primarily concerned with the inspection jobs of

certain stages. They have not been given enough responsibility to coordinate all aspects of Q.C. activities and to take influential actions. The chief success of their Q.C. function may be attributed to the rather high proportion of employees (7.3%) directly involved in the inspection jobs and their hard work. However a company's profits may be substantially increased by introducing more sampling methods to reduce the inspection load. Many factories in answering the questionnaire, have expressed the opinion that good human relationships are much harder to achieve than good quality control technology. It has also been pointed out in Section 7 that some general troubles with the supply of materials exist.

It thus appears that four principles will be helpful in better organising the Q.C. system, given the present situation. First the top management must not only be interested in but also must have sufficient knowledge and appreciation of the modern approach to quality and reliability in order to give the right lead and especially in order to run a Q.C. department of more work elements. (Reference may be made to Feigenbaum [3]). Second the inspection force may be appropriately reduced by introducing more efficient sampling methods, including cutting out some redundant inspection steps. Third good personnel management is essential, and improved medical and housing benefits and other welfares will certainly turn out to be a rewarding policy in the long run (especially in these days of high turnover rates of employees). Finally closer links and better communication between the company and the vendor regarding productivity and Q.C. practices is advantageous to both parties.

More Technical Education. Never has the need for efficient quantitative management in industry been so acute as today. In almost all sectors of a company statistical methods, elementary or advanced, find their applications as a means of collecting and providing quantitative information for decision making. This situation is especially true for the quality control function. We have seen in the above sections that generally the advantage of statistical method has not been sufficiently appreciated and applied. There has been little awareness of more recent

techniques such as cusum charts, Bayesian acceptance sampling plans, continuous sampling inspection, and the like.

The design and production of a larger variety of goods, especially those of higher quality and price, is significantly important for the industry to grow and prosper. However, investments in technical research and technical education have been insufficient.

In view of these problems more fully supported and inexpensive training courses on statistical method, quality control, and the technological science, for all levels of persons in the industry, are urgently needed.

Large Scale Activities. Many industrial countries have nation-wide organisations or activities orientated toward quality control and reliability in order to raise their quality standard and to build up their reputation of quality. The United States has an American Society for Quality Control (ASQC) and the Military Standard; Japan has a Union of Japanese Scientists and Engineers (JUSE), a JIS mark of approved quality, an annual 'quality month', and a Deming prize for quality control; the European countries have a European Organisation for Quality Control (EOQC); Britain has an Institution of British Standards (BSI), a National Council for Quality and Reliability (NCQR), and a Royal Statistical Society, Industrial Applications Section (RSS/IAS). Such efforts are very useful to promote quality control interest. In Hong Kong no similar large scale activities have been organised, but they are highly desirable. A good beginning could be to run an Electronics Quality and Reliability Week (EQR Week). An annual prize to be awarded to the company which has best practised quality control in the year is worth launching.

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SURVEY OF THE CURRENT STATUS OF QUALITY CONTROL IN THE ELECTRONICS INDUSTRY
電 子 工 業 之 品 質 管 制 實 況 調 查

CONFIDENTIAL 機 密

DECEMBER, 1970. 一九七〇年十二月

NAME AND ADDRESS OF FACTORY 廠號名稱及地址_____

QUESTIONS 問題：—

I. G E N E R A L 一般事項

(1) Please describe the main products of your Factory. 請簡述貴廠之主要產品。

(a) Transistor radios 原子粒收音機 ☐
(b) Transistors 電晶體（即半導體） ☐
(c) Memory core planes 記憶磁芯平面 ☐
(d) T. V. parts 電視機配件 ☐
(e) Others 其他(Specify 請說明_____) ☐

(2) Sales of product: 產品銷售情況：

(a) Direct to U. S. A. 銷往美國 ____%
(b) Direct to Europe 銷往歐洲 ____%
(c) Direct to Japan 銷往日本 ____%
(d) Direct to other places abroad 銷往其他外地 ____%
(e) To exporters 售與出口商 ____%
(f) To local market 供應本地市場 ____%
(g) To local contractors 售與本地包工之廠家 ____%

(3) The principal investment in your Factory is 貴廠之主要資金成份爲

(a) Hong Kong capital 港資 ☐
(b) American capital 美資 ☐
(c) Japanese capital 日資 ☐
(d) Others 其他(Specify 請說明 _____) ☐

(4) Total number of employees: 現有全部員工人數：

(a) 1 - 99 一至九十九 ☐
(b) 100 - 199 一百至一九九 ☐
(c) 200 - 499 二百至四九九 ☐
(d) 500 - 999 五百至九九九 ☐
(e) 1000 - 1999 一千至一九九九 ☐
(f) 2000 or over 二千或以上 ☐

(5) Please complete the following table about the educational standards of your workers. 請將下列有關貴廠工人學歷之表格填妥

	Assemblers 裝配工	Inspectors/Auditors 檢查員／稽核員	Supervisors/Formen 領班／管工
Primary 6 or below 小學或以下程度	%	%	%
Secondary school 中學程度	%	%	%
Technical College 工業學院	%	%	%
University level 大學程度	%	%	%
Total 總計	100%	100%	100%

II. ORGANIZATION OF QUALITY CONTROL
品 質 管 制 之 組 織

(6) After the establishment of your Factory, when was the Quality Control/Quality Assurance Department organized ? 品質管制／品質保證部於建廠後何時成立？

(a) Same time 同時 ☐
(b) One year later 一年後 ☐
(c) Two years later 二年後 ☐
(d) Over two years later 超過二年後 ☐
(e) Not yet established 還未成立 ☐

(7) The Q.C./Q.A. Department is 品質管制／保證部是

(a) independent, directly under the Plant Manager 直屬廠長與其他部門平行 ☐
(b) a section in another department 隸屬其他部門 (Specify 請說明 _____) ☐

(8) Has the Q.C./Q.A. Department been expanded since its establishment ? 品質管制／保證 部自成立以來有無擴展？

(a) Yes 有 (Describe 請略述_____) ☐
(b) No 無 ☐

(9) If Q.C./Q.A. Department is non-existing, who in in charge of quality control activities ? 若貴廠尚未設立品質管制／保證部，誰人主理品管事務？

Ans. : 答案: Position 職稱_____ Department 所屬部門_____ Other duties 其他任務_____

(10) Any Q.C. Committee formed by all department heads in operation ? 有否設立各部門主任組成之品質管制委員會？

(a) Yes 有 (Is it efficient? 有成效否？___) ☐
(b) No 無 ☐

(11) What kind of "Quality Consciousness Promotion" campaigns has baen carried out in 1970 ? 一九七〇年內，貴廠曾推行過何種「提高品質意識」之運動？

(a) Posters 張貼標語 ☐
(b) Competitions 品質成績比賽 ☐
(c) Meetings of staff and/or workers 召開員工會議 ☐
(d) Other ways 其他方法 (Specify 請說明 _____) ☐
(e) No such campaigns 無此種運動 ☐

(12) Quality control activities of workers : 工人之品質管制活動：

(a) Setting up Q.C. Circles 組織品管圈 ☐
(b) Setting up Z.D. Groups 組織無缺點隊 ☐
(c) Making constructive suggestions 提供具體意見 ☐
(d) Other activities 其他活動 (Specify 請說明 _____) ☐
(e) No special activities 無任何特殊活動 ☐

(13) Please complete the following table about quality control staff and workers(*) in your Factory.
請將下列有關貴廠品質管制各級員工「註」情況之表格填妥。

	Top level Q.C. staff 高層品管職員 (Engineer grade or above) (工程師級以上)	Mid-level Q.C. staff 中層品管職員 (Supervisors, techniciens etc.) (管工、技術員等)	Inspectors/ Auditors 檢查員／稽核員
No. employed 現有人數			
Present vacancies 現有空缺			
No. joined internal training classes 曾參加廠內之訓練班人數			
No. joined external training classes 曾參加廠外組開之訓練班人數			
No. attended training courses abroad 曾參加外國之訓練班人數			

(*) Includes all members of the Q.C./Q.A. Department and other departments, whose duty is to inspect and assure the quality and reliability of materials and products.
「註」包括品質管制／保證部全部員工及其他部門之員工，其工作範圍爲檢查與保證物料與產品之質素及可靠性者。

III. QUALITY CONTROL AT VARIOUS STAGES OF PRODUCTION
生 產 各 階 段 之 品 質 管 制

(14) Incoming material inspection is practised by 進料檢查工作由

(a) members of Q.C./Q.A. Department 品質管制／保證部人員擔任 ☐
(b) members of Production Department 生產管理部人員擔任 ☐
(c) members of other department 其他部門人員擔任 (Specify 請說明_____) ☐

(15) The origin of principal incoming material: 主要原料之來源地：

(a) Hong Kong 本港 ☐
(b) U.S.A. 美國 ☐
(c) Japan 日本 ☐
(d) Europe 歐洲 ☐
(e) Other places 其他地方 (Specify 請說明_____) ☐

(16) Supply of materials : 原料供應情況：

(a) Quite punctual 頗爲準時 ☐
(b) Often delayed 時有遲誤 ☐

(17) Majority of delayed incoming materials is supplied by 發生遲誤之原料大多由

(a) local vendors 本地廠家供應 ☐
(b) foreign vendors 外地廠家供應 ☐
(c) branch/same factory 分廠／本廠供應 ☐

(18) Main reason for delay : 遲誤之主要原因：

(a) Late placement of orders 訂購太遲 ☐
(b) Difficulty in transportation 運輸困難 ☐
(c) Vendor's poor productivity 供應廠家生產力有困難 ☐
(d) Intentional delay by vendor to avoid rejection 對方故意延遲，避免退貨 ☐
(e) No competitive vendors 供應商無競爭對手 ☐
(f) Others 其他 (Specify 請說明_____) ☐

(19) Number of vendors disqualified by your Factory in the past 3 years : 過去三年供應商被貴廠除名之數目：

(a) 0 零 ☐
(b) 1 - 3 一至三 ☐
(c) Over 3 三以上 ☐

(20) The officer in charge of product designing is in 產品設計之主管人屬於

(a) Engineering Department 工程部 ☐
(b) Production Department 生產部 ☐
(c) Q.C./Q.A. Department 品質管制／保證部 ☐
(d) Other department 其他部門 (Specify 請說明_____) ☐

(21) Change of existing quality standards : 品質規格之改變：

(a) Frequently changed 經常改變 ☐
(b) Occasionally changed 偶有改變 ☐
(c) Never changed 從無改變 ☐

(22) Main reason for change of existing quality standards : 品質規格改變之主要原因：

(a) Request by customers 客戶要求 ☐
(b) Suggestion by Q.C./Q.A. Department 品質管制／保證部之建議 ☐
(c) Customers' complaints 顧客訴怨 ☐
(d) Market competition 市場競爭 ☐
(e) Others 其他 (Specify 請說明_____) ☐

(23) In the design of new products, the Q.C./Q.A. Department is 設計新產品，品質管制／保證部

(a) often consulted 常有提供意見 ☐
(b) never consulted 從無提供意見 ☐

(24) The in-process inspections are undertaken by 在製程中，產品檢查工作由

(a) shop operatives 現場操作工人兼任 ☐
(b) members of Q.C./Q.A. Department 品質管制／保證部人員擔任 ☐
(c) members of Production Department 生產管理部人員擔任 ☐
(d) members of other department 其他部門人員擔任 (Specify 請說明_____) ☐

(25) The rate of finished products that need rework or repair before leaving Factory : 出廠前，產品需要重加工或修理之比率：

(a) Quite serious 頗爲嚴重 ☐
(b) Not serious 並不嚴重 ☐

(26) Outgoing product inspection is carried out by 出廠產品檢查工作由

(a) Q.C./Q.A. Department 品質管制／保證部負責 ☐
(b) Production Department 生產管理部負責 ☐
(c) Finished Product Department 成品部負責 ☐
(d) Other department 其他部門負責 (Specify 請說明_____) ☐

(27) The proportion of defective pieces returned by customers out of total output : 被買家退回之廢品件數與總產量之比例：

(a) Under 5% 五巴仙以下 ☐
(b) 5 - 9% 五至九巴仙 ☐
(c) 10 - 20% 十至二十巴仙 ☐
(d) Over 20% 二十巴仙以上 ☐

(28) Is the production schedule often completed punctually ? 貴廠之生產計劃通常能依期完成否？

(a) Yes 能 ☐
(b) No 不能 ☐

(29) In which of the following stages does your Factory apply 100% inspection ? 貴廠在下列那些階段中會施用全數檢驗法？

(a) Incoming material acceptance 接收進料時期 ☐
(b) In-process 生產綫中段製程時期 ☐
(c) Last step of process 製程完成時期 ☐
(d) Finished product 製成品時期 ☐

(30) Please indicate the sampling inspection tables and probability levels used by your Factory.
貴廠所採用之抽樣檢驗表及機率水準。

[Answer with a tick "✓" except in (d) and (h). 除(d)及(h)欄外，其餘請用(✓)號作答。]

		Incoming material 進料	Process 製程	Finished Product 成品
Inspection tables 檢驗表	(a) MIL-STD 105D 美軍標準 105D			
	(b) Dodge and Romig 杜奇雷敏			
	(c) Self-established table 自己訂立之檢驗表			
	(d) Others (Specify) 其他 （請說明）			
Probability levels 機率水準	(e) LTPD 拒收水準			
	(f) AOQL 平均出廠品質界限			
	(g) AQL 允收水準			
	(h) Others (Specify) 其他 （請說明）			

(31) Indicate other statistical techniques used in your Factory. 請列明貴廠所採用之其他統計技巧。

	In use 已有採用	Not in use 未有採用
(a) Daily Record of Percent defective 每日不良率紀錄表		
(b) Cause and effect diagram 要因分析圖		
(c) Pareto's Diagram 柏力道分析圖		
(d) Histogram 直方圖		
(e) $\bar{X}$ - R Control Chart $\bar{X}$ — R管制圖		
(f) p - Control Chart p — 管制圖		
(g) Demerit rating system 劣點評分法		
(h) Experimental design 實驗設計		
(i) Correlation analysis 相關分析		
(j) Others 其他(Specify 請說明 _____)		

V. MISCELLANEOUS 其 他

(32) Is there any sound feedback system for utilizing the information obtained from customers' complaints or market research ? 貴廠有否健全回輸制度以運用由顧客訴怨或市場研究所得之資料？

(a) Yes 有 ☐ (b) No 無 ☐

(33) Has your Factory ever made use of the laboratories of other organizations to test or prove incoming or outgoing quality ? 貴廠有否借用其他機構之實驗室以試驗或證明進廠或出廠之品質？

(a) Yes 有(Specify the organization 請指出機構名稱_____) ☐ (b) No 無 ☐

(34) Does Q.C./Q.A. Department play any role in the maintenance of equipments and guages ? 品質管制／保證部有否參與機件及量規之保養事務？

(a) Actively 積極 ☐ (b) Occasionally 偶然 ☐
(c) Never 永不 ☐

(35) Assemblers' and operatives' working attitude : 裝配工及操作工之工作態度：

(a) Do as instructed 依照指示去做 ☐ (b) Keen to achieve quality requirement 切望達到品質之要求 ☐
(c) Sometimes disobey instructions 有時不依指示去做 ☐

(36) Estimate of quality control cost out of total cost : 品管費用約佔總成本之：

(a) _____% ☐ (b) No estimate 無估計 ☐

(37) The most appreciable result of your Factory from the practice of quality control : 實施品質管制之最顯著成果：

(a) Quality improved 品質改良 ☐ (b) Cost reduced 成本降低 ☐
(c) Market extended 市場擴展 ☐ (d) Others 其他 (Specify 請說明 _____) ☐

(38) Do you agree with the following statements about Hong Kong Electronics Industry ? 閣下同意下述有關本港電子工業之問題否？

(i) The top management of most factories does not lay enough stress on quality control. 多數廠之高層人仕未能重視品質管制。

(a) Yes 是 ☐ (b) No 否 ☐
(c) Other opinions 其他意見 ☐ (d) No idea 無意見 ☐
(Describe 請簡述 _____) ☐

(ii) The method of controlling quality in most factories is still not satisfactory. 多數廠之品質管制方法仍未臻理想。

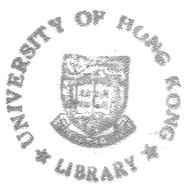
(a) Yes 是 ☐ (b) No 否 ☐
(c) Other opinions 其他意見 ☐ (d) No idea 無意見 ☐
(Describe 請簡述 _____) ☐

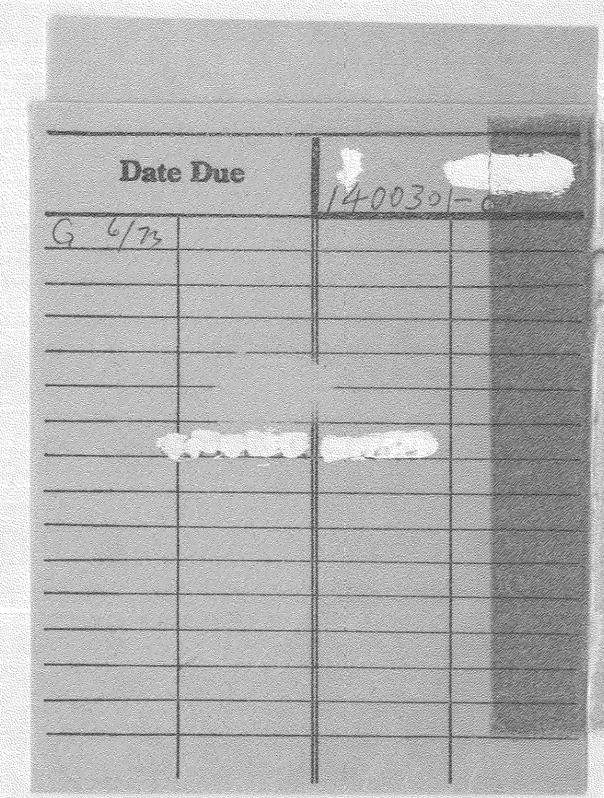
(iii) Good relationship among employees is more difficult to achieve than satisfactory quality control technology. 良好之員工關係較完善之品管技術更難以獲致。

(a) Yes 是 ☐ (b) No 否 ☐
(c) No idea 無意見 ☐

(39) Please explain the main difference between the jobs of Q.C. and Q.A. in your Factory. 貴廠之「品質管制」及「品質保證」兩方面之工作範圍有何主要分別？請略述之。

(40) Please state briefly any other opinions you have about the quality control of your Factory or of the Hong Kong Electronics Industry. 如閣下對貴廠或本港電子工業之品質管制有其他意見，請扼要列述於下。





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